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บทความวิจัย

A Lesson Learned from the UK Rail Project: An Analysis of Critical Success Factors (CSFs) through the Project Life Cycle (PLC)

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Abstract: This study examines the critical success factors (CSFs) of railway construction projects through the lens of the Project Life Cycle (PLC), addressing the defining, planning, implementing, and closing phases. Although CSFs have been widely studied, their systematic application to Thailand's railway sector remains limited, particularly in linking lessons from international best practices. Employing a systematic literature review and content analysis, the research synthesizes evidence from major United Kingdom projects, including Crossrail and High Speed 2 (HS2), and compares them with experiences in Thailand. The analysis identifies governance, stakeholder collaboration, and risk management as decisive CSFs across all PLC phases. Key findings highlight that early participatory consultations enhance legitimacy, structured risk registers and stakeholder mapping strengthen planning, while real-time monitoring and independent audits improve implementation oversight. In the closing phase, structured handovers and training programs are vital for operational continuity. By integrating international lessons with a PLC perspective, this study provides policymakers and practitioners with a structured framework for improving the governance, efficiency, and sustainability of Thai railway projects. Beyond this sectoral focus, the PLC–CSFs framework demonstrates wider applicability to large-scale infrastructure initiatives, contributing to both theoretical advancement and practical guidance for sustainable transport development in Thailand.

Keywords: Rail Project; Critical Success Factors; Project Life Cycle

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1. Introduction

Rail transport plays a pivotal role in industrial development and socioeconomic growth, particularly in facilitating domestic and international trade. Projects involving constructing of railways are inherently complex due to their size, duration, linear site characteristics, high investment, and involvement of several organizations [1]. In Thailand, the national infrastructure strategy (2015–2022) prioritizes railway development, with a particular emphasis on double-track projects. Despite this strategic importance, Thailand's railway development has repeatedly encountered delays and cost escalations across various project types. For example, the completed Chira Junction–Khon Kaen double-track line was marked by disputes over land acquisition and procurement, which exposed persistent challenges in governance and inter-agency coordination [2]. Current double-track projects continue to face difficulties stemming from overlapping institutional responsibilities, inadequate monitoring systems, and recurrent budget revisions. High-speed rail initiatives, particularly the Bangkok–Nakhon Ratchasima project, have been further impeded by political uncertainties, financing constraints, and protracted negotiations with international partners, leading to recurring extensions of project timelines [3]. Collectively, these recurring obstacles—land acquisition disputes, procurement inefficiencies, weak oversight, and political as well as financial instability not only undermine the timely delivery of anticipated public benefits but also exacerbate financial burdens. Such issues underscore the pressing need for governance reforms, proactive risk management, and systematic stakeholder engagement in Thailand's railway sector.

To confront these challenges, the analytical framework of Critical Success Factors (CSFs) has gained prominence in infrastructure and project management research since the foundational contributions of Pinto and Slevin [4]. CSFs refer to a limited number of key areas where satisfactory performance ensures successful project outcomes. Through the utilization of the Project Life Cycle (PLC) paradigm, which encompasses the processes of defining, planning, implementing, and closing, CSFs can be methodically assessed to discover their function at every step of project development [5]. The integration of PLC with CSFs analysis is particularly significant as it not only isolates the most influential factors but also clarifies their temporal relevance and mechanisms of impact, thereby equipping project managers with actionable insights throughout the project's progression.

This study adopts a comparative perspective by examining railway projects in the United Kingdom (UK), notably Crossrail and High-Speed 2 (HS2). These projects present instructive parallels with Thailand in terms of extensive government investment, reliance on public–private partnerships, stakeholder diversity, and recurring challenges of

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cost escalation and schedule slippage. At the same time, UK projects have demonstrated comparatively stronger governance structures and stakeholder engagement mechanisms, offering valuable lessons applicable to the Thai context. While international scholarship has extensively explored CSFs, studies that apply a PLC-based perspective to Thailand's railway industry remain scarce. Addressing this gap not only enhances theoretical understanding but also provides practical contributions to policy and practice in infrastructure delivery.

In light of these considerations, this research pursues three core objectives: (1) to identify the CSFs across the four phases of the PLC; (2) to extract lessons learned from UK railway projects; and (3) to propose strategies for enhancing the performance of Thailand's railway development initiatives, with particular focus on double-track projects.

2. Methodology

This study adopted a qualitative research design based on an extensive literature review and documentary analysis. The methodological process consisted of four stages: (1) literature identification and selection, (2) content analysis, (3) drawing lessons from UK rail experiences, and (4) synthesizing suggestions for Thailand.

2.1 Literature identification and selection

Prominent databases such as Scopus, Web of Science, and Google Scholar were used to obtain pertinent scholarly articles and official reports. "Critical success factors," "railway project," "project life cycle," and "cost overrun" were the keywords utilized. Publications from 1980 to 2022 that addressed both construction management and transportation-related topics were the focus of the search. The study had to cover CSFs, success criteria, project performance; it had to adopt or be pertinent to PLC stages. From an initial pool of 167 articles, thirteen papers met the criteria and were systematically reviewed.

2.2 Content analysis

To extract CSFs and map them onto the PLC framework, content analysis was used. 1. Coding the factors mentioned in each study; 2. Classifying them into the four PLC phases (definition, planning, implementation, and closure); 3. Finding the factors that are most emphasized by calculating the frequency of occurrence; 4. To guarantee conceptual consistency, cross-check with theoretical frameworks.

2.3 Extraction of lessons from UK rail projects

The lessons analyzed in this study were derived from major UK rail initiatives, particularly Crossrail [6], HS2 [7], and the Crossrail Learning Legacy database [8], together with official reports

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from the UK Department for Transport. These sources provided evidence of both successes and challenges, which were synthesized into lessons relevant for Thai railway development. Emphasis was placed on identifying practices that strengthened project governance, enhanced stakeholder participation, and improved risk management, thereby offering transferable insights for Thai railway projects.

2.4 Synthesis of recommendations for Thailand

To produce context-specific suggestions for Thailand's railway projects, the CSFs found through content analysis were finally combined with the case findings from the UK. The study examined quantitative information for Thailand's railway industry in addition to case studies from the UK. The goal of the synthesis process was to (a) identify techniques that may be applied in different countries, (b) adapt them to fit the institutional and socioeconomic context of Thailand, and (c) create practical recommendations for practitioners, policymakers, and project managers

3. Results

3.1 The CSFs across the four PLC phases

CSFs determine a project's success, and the efficacy of these elements is frequently linked across various phases. The top three most important parameters for each PLC phase were determined by analyzing 41 CSFs from earlier studies (1980–2022). This method emphasizes how CSFs in one phase impact those in the next and provides a more organized guide than a generic list (Tables 1a – 1d).

Table 1a Top three CSFs in the defining phase

Rank (Score 0-5)	CSF	References	Rationale
1 (4)	Clear mission, goals, and objectives	Ikele et al. [9]	Establishes project vision and prevents scope ambiguity
1 (4)	Stakeholder consultation and engagement	Khang & Moe [10]	Early involvement reduces later conflicts
3 (3)	Competency of project designers and promoters	Khang & Moe [10]	Ensures feasibility and realistic expectations

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Table 1b Top three CSFs in the planning phase

Rank (Score 0-5)	CSF	References	Rationale
1 (5)	Adequate resource allocation (finance, workforce, equipment)	Abeysekara et al. [11]	Prevents delays and cost overruns
1 (5)	Risk management and contingency planning	Pinto & Slevin [4]; Ikele et al. [9]	Anticipates uncertainties and mitigates failures
3 (4)	Early supply chain and stakeholder involvement	Wuni & Shen [12]	Strengthens coordination and trust

Table 1c Top three CSFs in the implementation phase

Rank (Score 0-5)	CSF	References	Rationale
1 (5)	Strong project leadership and troubleshooting	Pinto & Slevin [4]	Guides team and resolve on-site challenges
2 (4)	Quality control and auditing mechanisms	Hassan et al. [13]	Ensure compliance with standards
2 (4)	Skilled workforce and technical expertise	Wuni & Shen [12]	Maintains efficiency and productivity

Table 1d Top three CSFs in the closing phase

Rank (Score 0-5)	CSF	References	Rationale
1 (3)	Competence of project manager during handover	Khang & Moe [10]	Facilitates smooth transition to operations
1 (3)	Documentation and knowledge transfer	Niu et al. [14]	Preserves institutional learning
3 (2)	Establishing long-term cooperation with operators	Niu et al. [14]	Sustains project benefits and service quality

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Together, the score values (0–5) represent the frequency with which a factor was emphasized in the reviewed literature, with “5” indicating the highest recurrence and influence of a factor. The tables reveal that CSFs are emphasized during the planning and implementation phases, particularly in the areas of resource allocation, risk management, and leadership. Conversely, the closure phase has received relatively less emphasis in the literature, although effective documentation and long-term cooperation remain essential for project sustainability.

By defining the project’s core vision and objectives, the defining phase lays the groundwork for success (Table 1a).

The planning phase is immediately impacted by the results of the defining phase, such as well-defined objectives and early, stakeholder support. The framework required for successful execution is provided by proper resource allocation and risk management set up during the planning phase (Table 1b).

Strong project leadership throughout implementation facilitates more efficient project closure (Table 1c). A formal conclusion and handover of the project to the operations team occurs during the closing phase. The project manager’s ability to provide an effortless transition to the operational stage during the handover is the most crucial aspect of this phase (Table 1d).

3.2 Lessons from the UK’s rail projects

To strengthen the comparative analysis, this study reviewed lessons from the UK’s two largest rail projects [6, 7]. These initiatives offer valuable insights into structuring governance, stakeholder engagement, and risk management practices. By mapping the key lessons to the PLC, the findings highlight practical mechanisms that could be adapted to improve Thai railway projects. Table 2 presents these key lessons in relation to each PLC phase.

3.2.1 Comparative Analysis: UK vs Thailand

Table 3 demonstrates the railway projects in both the UK and Thailand encounter recurring delays and cost overruns, yet their responses differ markedly. In the UK, despite overruns in [6, 7], mechanisms such as parliamentary reviews, statutory consultations, and independent cost boards enhance accountability and institutional learning. By contrast, Thai projects continue to face land acquisition disputes, procurement conflicts, and weak monitoring, resulting in delays of 40–60% in double-track construction [15] and over 80% in high-speed rail [5].

Governance frameworks: UK projects benefit from clearly defined governance structures, independent oversight, and transparent parliamentary review processes, which reinforce accountability and policy continuity. Thai projects, however, often

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suffer from fragmented responsibilities and policy discontinuity, as seen in the [5], where overlapping agency roles and delayed decisions contributed to cost overruns.

Stakeholder collaboration: The UK institutionalizes early stakeholder engagement through statutory consultation, reducing resistance to land acquisition. For example, [7] established formal consultation processes before construction. Thailand, by contrast, continues to face disputes with landowners and communities, exemplified by the [2, 3] which were delayed by expropriation conflicts and contested contracts.

Risk management: Initiative-taking risk anticipation in UK projects is supported by tools such as BIM and real-time monitoring dashboards, enabling timely corrective actions. In Thailand, risk management is largely reactive, with double-track projects under construction averaging 40–60% delays and high-speed rail exceeding 80%, reflecting systemic weaknesses in monitoring and contingency planning.

In summary, Thailand's challenges concentrate in the defining and planning phases, where weak feasibility studies, land disputes, and procurement issues create cascading inefficiencies during implementation and closing. Conversely, the UK experience demonstrates that institutionalized governance, stakeholder consultation, and initiative-taking risk management reduce uncertainties and strengthen delivery. These contrasts form the foundation for the actionable recommendations outlined in the following section.

3.3 Recommendations for Thailand

To address the third objective of this study—deriving actionable guidelines for improving Thai railway projects—the following recommendations are synthesized from the comparative analysis of CSFs across the PLC and the lessons learned from UK projects. These strategies are tailored to Thailand's institutional context to strengthen governance, stakeholder engagement, and risk management throughout the project lifecycle.

Building on UK lessons and Thai evidence, actionable strategies are proposed for each PLC phase as follow:

3.3.1 Defining phase

Institutionalize participatory pre-project evaluations and transparent feasibility reviews. Early consultation would mitigate politically influenced studies and reduce land disputes.

3.3.2 Planning phase

Mandate risk registers and stakeholder mapping as part of official submissions. These tools anticipate conflicts such as those in [2] and [3].

3.3.3 Implementation phase

Adopt real-time monitoring and independent audits, similar to Crossrail's digital dashboards, to reduce cost overruns and contractor delays.

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Table 2 Key Lessons from UK Rail Projects by PLC Phase

PLC Phase	UK Lesson (Crossrail / HS2)	Relevance for Thai Railway Projects
Defining	Sponsor-led, independent delivery unit (Crossrail Ltd) with clearly defined roles	Emphasizes need for clear project governance and stakeholder clarity at project inception
Planning	Early establishment of SMART KPIs driving alignment across team and phases	Supports performance-based planning, cost control, and accountability
Implementation	Digital risk registers with health & safety focus (HS2), and digital construction data tracking	Demonstrates value of initiative-taking monitoring, Building Information Modelling (BIM), and centralized risk tracking
Closing	Structured learning legacy capturing institutional knowledge and best practices	Suggests creating a knowledge repository and handover protocols for Thai rail projects

Table 3 Comparative Delay Factors in UK and Thai Rail Projects Mapped to PLC Phases

PLC Phase	UK: Institutional Practices & Success Factors	Thailand: Delay Factors & Evidence
Defining	Statutory consultations; feasibility reviewed by parliament.	Politically influenced feasibility (Bangkok – Nakorn Ratchasima high-speed [3]
Planning	Independent cost boards; phased budgeting; transparent procurement.	Weak early engagement; land disputes, delays in contractor appointment, cost underestimation; fragmented coordination; land expropriation disputes (Bangkok – Nakorn Ratchasima high-speed [3], >80% delays, Ban Phai – Nong Pok [15]).
Implementation	BIM, dashboards, and independent audits for initiative-taking monitoring.	Contractor delays; weak oversight; design issues (Ban Phai – Nong Pok [15], double-track delays 40–60%)
Closing	Learning Legacy programs transfer knowledge.	Lack of systematic reviews and handover protocols; repeated inefficiencies (Thanon Jira Junction –Khon Kaen [4] readiness delays).

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3.3.4 Closing phase

Establish structured handover protocols and training for operations staff, supported by a public “Learning Legacy” repository to prevent knowledge loss. These recommendations underscore governance reforms, proactive risk management, and institutionalized stakeholder engagement as essential strategies for advancing Thailand’s railway sector. Adapted from UK practices but tailored to the Thai context, they not only address recurring delays in project implementation but also strengthen the long-term sustainability of national transport infrastructure. Following these guidelines could help Thailand's rail projects operate glued to their schedules, guaranteeing effective operation and boosting public confidence in the system.

3.3.5 Actionable Recommendations for Thai Railway Projects

Building on the comparative analysis, four priority areas emerge across the PLC: participatory pre-project evaluation (defining), systematic risk registers and stakeholder mapping (planning), real-time monitoring with independent audits (implementation), and structured handover with capacity building (closing). These strategies, consolidated in Table 4, highlight how lessons from UK railway projects can be adapted to strengthen governance, risk management, and stakeholder engagement in Thai rail projects.

4. Discussion

The PLC framework proved effective in mapping CSFs across rail projects, supporting [4] emphasis on reinforcing success factors throughout the lifecycle and [5] validation of PLC as a reliable evaluation tool. Applied to the Thai context, the analysis highlights persistent weaknesses in governance, stakeholder engagement, and risk management.

4.1 Governance

Thai projects continue to suffer from overlapping responsibilities and delayed decisions, as illustrated by [3]. By contrast, UK projects institutionalize parliamentary oversight and independent boards, which improve continuity and transparency.

4.2 Stakeholder engagement

Community resistance and land disputes have caused extensive delays in Thai projects, including [2, 3]. The UK approach, exemplified by HS2, demonstrates that statutory consultations and early engagement can reduce resistance and enhance legitimacy.

4.3 Risk management

While UK projects employ initiative-taking mechanisms such as BIM and real-time dashboards, Thai projects remain reactive. This is reflected in delays of 40–60% in [2], and more than 80% in high-speed rail initiatives [3], with major financial consequences.

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Table 4 Weaknesses and recommendations for Thai rail projects across the PLC

PLC Phase	Key Weaknesses in Thailand	Relevant CSFs	Lessons from UK	Recommendations for Thailand
Defining	Politically influenced feasibility studies; limited stakeholder engagement, land disputes	Clear objectives; stakeholder involvement; risk assessment	Comprehensive demand modelling; statutory consultations	Independent feasibility review; demand-driven planning; institutionalizes early community consultation
Planning	Cost estimation errors, budget revisions; fragmented coordination; land expropriation delays	Accurate cost/time estimation; integrated planning; governance structures	Independent cost boards; phased budgeting	Establish cost verification committees; integrated planning units; transparent land compensation
Implementation	Contractor delays due to procurement disputes; weak monitoring; reactive safety oversight	Contractor capacity; risk monitoring; safety management; communication	Digital monitoring systems; independent safety regulators	Contractor capacity proof; BIM/digital dashboards; independent safety oversight
Closing	Lack of systematic post-project review; limited knowledge transfer; weak maintenance integration	Knowledge management; post-project review; sustainability planning	Post-completion audits; “Learning Legacy”	Post-project evaluations; public knowledge repositories; integrated maintenance plans

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Overall, governance, stakeholder collaboration, and risk management emerge as interdependent CSFs that decisively influence project performance. Strengthening these areas could shift Thai railway projects from recurring inefficiencies toward improved accountability, timeliness, and sustainability.

4.4 Public vs private roles

In the Thai context, most railway projects are state driven, with the Ministry of Transport (MOT), the SRT, and the Mass Rapid Transit Authority (MRTA) as primary sponsors. Consequently, governance weaknesses—such as overlapping mandates and political discontinuity—reflect challenges unique to public sector delivery. By contrast, private sector participation, particularly under Public Private Partnership (PPP) schemes, faces different bottlenecks, including procurement disputes and investment uncertainties. Recognizing these distinctions is essential for tailoring governance reforms and risk management tools to both public and mixed-delivery models.

4.5 Limitations and Directions for Future Research

This study is limited by its reliance on secondary sources, which, while valuable, may not fully reflect the contextual realities of Thai railway projects. The comparative framework with the UK provides useful lessons but risks over-generalization due to institutional and legal differences. Furthermore, the absence of primary data, such as interviews or stakeholder surveys, constrains the depth of contextual understanding. Future research should therefore employ field-based methods—including case studies and direct stakeholder engagement—to validate and enrich the applicability of the PLC–CSFs framework in Thailand and to generate more actionable policy recommendations.

5. Conclusion

The study fulfilled three objectives: it identified the CSFs across the four stages of the PLC, extracted lessons from United Kingdom railway projects, and translated these insights into actionable guidelines for Thai railway initiatives. The findings highlight governance reform, stakeholder collaboration, and initiative-taking risk management as decisive factors for improving delivery in large-scale transport projects. By linking the UK's technology-driven risk management and statutory consultation practices to Thailand's challenges—such as land acquisition and procurement disputes—this study demonstrates how cross-national learning can inform more efficient, accountable, and sustainable project implementation. Beyond the immediate focus on rail, the PLC–CSFs framework also provides broader analytical utility for motorways, logistics hubs, and smart city infrastructure, thereby contributing to both scholarly debates and practice-oriented strategies for sustainable development.

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5.1 Policy Implications

The results point to clear operational pathways for Thai transport governance. At the defining phase, the MOT and Department of Rail Transport (DRT) should institutionalize statutory consultations to strengthen legitimacy and stakeholder alignment. At the planning phase, agencies and private contractors need to embed risk registers and stakeholders mapping into project approval protocols to anticipate and mitigate disputes. At the implementation phase, organizations such as the SRT and the MRTA must adopt real-time monitoring systems and independent audits as standard tools to ensure accountability and transparency. Finally, at the closing phase, structured handover mechanisms and capacity-building programs for operational staff are essential for sustaining long-term performance. Embedding these measures within national transport strategies and regulatory frameworks would not only enhance the timeliness and efficiency of rail projects but also reinforce investor confidence and institutional resilience across Thailand's wider infrastructure sector.

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